CLAIMS:

1. A rotating electrical machine, comprising:

a superconductive rotor coil; and

a rotatable shaft, comprising:

an axial passageway extending through the rotatable shaft; and

a first passageway extending through a wall of the rotatable shaft to the axial passageway, wherein the axial passageway and the first passageway are operable to convey a cryogenic fluid to the superconductive rotor coil.

2. The rotating electrical machine as recited in claim 1, further comprising a second passageway extending through the wall of the rotatable shaft to the axial passageway.

3. The rotating electrical machine as recited in claim 2, further comprising a first axial tube and a second axial tube disposed telescopically within the axial passageway.

4. The rotating electrical machine as recited in claim 2, further comprising a first axial tube and a second axial tube disposed side-by-side within the axial passageway.

5. The rotating electrical machine as recited in claim 3, wherein the first passageway is coupled to the first axial tube and the second passageway is coupled to the second axial tube.

6. The system as recited in claim 3, wherein the first axial tube and the second axial tube are doubled walled.

7. The rotating electrical machine as recited in claim 3, wherein the first axial tube and the second axial tube each comprise a coating operable to reduce the

emissivity of the first axial tube and the second axial tube to reduce radiative heat transfer to the cryogenic fluid.

8. The rotating electrical machine as recited in claim 2, further comprising a cryogenic transfer coupling disposed radially around the rotatable shaft, wherein the cryogenic transfer coupling is operable to direct cryogenic fluid to the first passageway and to receive cryogenic fluid from the second passageway.

9. The rotating electrical machine as recited in claim 1, wherein the rotating electrical machine is a generator comprising a stator.

10. The rotating electrical machine as recited in claim 1, wherein the first passageway and the second passageways extend radially though the rotatable shaft.

11. A system for cryogenically cooling a superconductive rotor coil, comprising:

a transfer coupling operable to be disposed radially around a rotatable shaft to couple cryogenic fluid between a source of cryogenic fluid and a passageway extending through the rotatable shaft, wherein the cryogenic fluid is coupled from the rotatable shaft to the superconductive rotor coil.

12. The system as recited claim 11, wherein the transfer coupling comprises a rotatable member secured to the rotatable shaft and a stationary member disposed in sealing arrangement with the rotatable member.

13. The system as recited claim 11, wherein the stationary member is aligned to direct cryogenic fluid into a first passageway in the rotatable shaft and to receive cryogenic fluid from a second passageway in the rotatable shaft.

14. The system as recited in claim 13, further comprising a first axial tube and a second axial tube disposed within the rotatable shaft, wherein the first

passageway directs cryogenic fluid into the first axial tube and the second passageway receives cryogenic fluid from the second axial tube.

15. The system as recited in claim 14, wherein the first axial tube and the second axial tube are oriented in a telescopic orientation.

16. The system as recited in claim 14, wherein the first axial tube and the second axial tube are oriented in a side-by-side orientation.

17. The system as recited in claim 13, wherein the first axial tube and the second axial tube are double walled vacuum-sealed tubes.

18. The system as recited in claim 13, wherein the first axial tube comprises a coating operable to reduce radiative heat transfer from the first axial tube to the cryogenic fluid.

19. The system as recited in claim 13, comprising a first radial tube disposed in the first passageway to thermally insulate the cryogenic fluid flowing through the first passageway from the rotatable shaft.

20. A method of cooling a superconductive rotor coil coupled to a rotatable shaft, the method comprising:

supplying a cryogenic fluid from a source of cryogenic fluid to a first passageway extending from an outer cylindrical surface of the rotor shaft to a first interior passageway extending axially through the rotatable shaft.

21. The method as recited in claim 20, further comprising returning the cryogenic fluid to the source of cryogenic fluid from the superconductive coil via a second passageway extending from a second interior passageway extending axially through the rotatable shaft to the outer cylindrical surface of the rotatable shaft.

22. The method as recited in claim 21, further comprising coupling a cryogenic fluid transfer manifold to the rotor shaft to couple the cryogenic fluid to the first passageway and to receive cryogenic fluid from the second passageway.

23. The method as recited in claim 22, wherein coupling a cryogenic fluid transfer manifold to the rotor shaft comprises securing a rotating manifold to the rotor shaft and disposing a stationary manifold adjacent to the rotating manifold to form a seal there between.

24. The method as recited in claim 21, further comprising directing the cryogenic fluid from the first interior passageway extending axially through the rotatable shaft to a rotor to cool the superconductive rotor coil.

25. The method as recited in claim 23, further comprising directing the cryogenic fluid from the rotor to the second interior passageway extending axially through the rotatable shaft.

26. A method of manufacturing a rotating superconductive device, comprising:

forming at least one axial passageway through a rotatable shaft;

forming an inlet passageway through a wall of the rotatable shaft to the at least one axial passageway to enable a cryogenic fluid to flow from an outer cylindrical surface of the rotatable shaft to the at least one axial passageway; and

coupling the rotatable shaft to a rotor comprising a superconductive material to enable the cryogenic fluid to flow from the at least one axial passageway to the superconductive material.

27. The method as recited in claim 26, further comprising: forming an outlet passageway through the wall of the rotatable shaft extending from the at least one axial passageway to the outer cylindrical surface of the rotatable shaft to enable the cryogenic fluid to flow from the at least one axial passageway to the outer cylindrical surface of the rotatable shaft.

28. The method as recited in claim 26, further comprising disposing a first tube in the at least one axial passageway and disposing a second tube within the first tube to define a first flow path for cryogenic fluid through the second tube and a second flow path for cryogenic fluid between the first tube and the second tube.

29. The method as recited in claim 26, wherein disposing the second tube comprises aligning an opening in the second tube with the first passageway when the second tube is disposed within rotatable shaft.

30. The method as recited in claim 26, wherein disposing the first tube comprises aligning an opening in the first tube with the second passageway when the first tube is disposed within rotatable shaft.

31. The method as recited in claim 26, wherein forming an inlet passageway comprises forming the inlet passageway at a location between each end of the rotatable shaft.

32. The method as recited in claim 27, wherein forming an outlet passageway in the rotatable shaft comprises forming the outlet passageway at a location between each end of the rotatable shaft.

33. A power generation system, comprising:

a generator comprising a superconductive rotor coil coupled to a rotatable shaft;

a first prime mover drivingly coupled to the rototable shaft;

a second prime mover drivingly coupled to the rototable shaft; and

a cryogenic transfer coupling disposed intermediate the first prime mover and the second prime mover to enable cryogenic fluid to be transferred to the superconductive rotor coil via the rotatable shaft.

34. The system as recited in claim 33, wherein the cryogenic transfer coupling is disposed radially around the rotatable shaft.

35. The system as recited in claim 34, wherein the rotatable shaft comprises an axial passageway extending through the rotatable shaft and an inlet passageway extending from a cylindrical surface of the rotatable shaft to the axial passageway.

36. The system as recited in claim 35, wherein the rotatable shaft comprises an outlet passageway extending from the cylindrical surface of the rotatable shaft to the axial passageway.

37. The system as recited in claim 33, wherein the first prime mover comprises a gas turbine.

38. The system as recited in claim 37, wherein the second prime mover comprises a steam turbine.

39. A generator, comprising:

a rotor comprising:

a superconductive rotor coil; and

a rotatable shaft operable to support the rotor and to receive cryogenic fluid to cool the superconductive rotor coil from a fluid inlet located on a side of the rotatable shaft; and

a cryogenic transfer coupling disposed adjacent to the rotatable shaft to supply cryogenic fluid to the fluid inlet.

40. The generator as recited in claim 39, wherein the rotatable shaft is operable to couple cryogenic fluid from the superconductive rotor coil to a fluid outlet located on the side of the rotatable shaft.

41. The generator as recited in claim 40, wherein the cryogenic transfer coupling is operable to receive the cryogenic fluid from the fluid outlet.